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JC682 U.S. PTO 03/15/02

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PTO/SB/05 (03-01)
Approved for use through 10/31/2002. OMB 0651-0032
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	
First Inventor	Chih-Chiang Chang
Title	OPTICAL VARIABLE ATTENUATOR ASSEMBLY
Express Mail Label No.	EL 870857375 US

JC986 U.S. PTO 10/099621 03/15/02

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [x] Fee Transmittal Form (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. [ ] Applicant claims small entity status. See 37 CFR 1.27.
3. [x] Specification [Total Pages 16]
   (preferred arrangement set forth below)
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. [x] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 7]
5. Oath or Declaration [Total Pages 2]
   a. [x] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 CFR 1.63 (d)) *(for continuation/divisional with Box 18 completed)*
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76
7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [x] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
11. [ ] English Translation Document *(if applicable)*
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [x] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [ ] Nonpublication Request under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. [ ] Other: .....

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____ / _____

Prior application information: Examiner _____ *Group Art Unit:* _____

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

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Name (Print/Type)	Wei Te Chung	Registration No. (Attorney/Agent)	43,325
Signature		Date	Mar 15 2002

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FEE TRANSMITTAL for FY 2002

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 780.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Chih-Chiang Chang
Examiner Name	
Group Art Unit	
Attorney Docket No.	

METHOD OF PAYMENT

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:
   Deposit Account Number
   Deposit Account Name
   ☐ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17
   ☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☒ **Payment Enclosed:**
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FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	740	201	370	Utility filing fee	740
106	330	206	165	Design filing fee	
107	510	207	255	Plant filing fee	
108	740	208	370	Reissue filing fee	
114	160	214	80	Provisional filing fee	

SUBTOTAL (1) ($) 740.00

2. EXTRA CLAIM FEES

		Extra Claims		Fee from below		Fee Paid
Total Claims	19	-20** = 0	X	18	=	0
Independent Claims	3	- 3** = 0	X	84	=	0
Multiple Dependent					=	

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	84	202	42	Independent claims in excess of 3
104	280	204	140	Multiple dependent claim, if not paid
109	84	209	42	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0.00

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	400	216	200	Extension for reply within second month	
117	920	217	460	Extension for reply within third month	
118	1,440	218	720	Extension for reply within fourth month	
128	1,960	228	980	Extension for reply within fifth month	
119	320	219	160	Notice of Appeal	
120	320	220	160	Filing a brief in support of an appeal	
121	280	221	140	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,280	241	640	Petition to revive - unintentional	
142	1,280	242	640	Utility issue fee (or reissue)	
143	460	243	230	Design issue fee	
144	620	244	310	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40
146	740	246	370	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	740	249	370	For each additional invention to be examined (37 CFR § 1.129(b))	
179	740	279	370	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 40.00

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Wei Te Chung	Registration No. (Attorney/Agent)	43,325	Telephone	408-919-6137
Signature				Date	Mar 15 02

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPOINTMENT OF DOMESTIC REPRESENTATIVE

Assistant commissioner for patents
Washington, D. C. 20231

Sir:

Wei Te Chung of Foxconn International, Inc., whose postal address is 1650 Memorex Drive, Santa Clara, CA 95050, is designated as Assignee's representative on whom communications relating to the assignment of the concurrent patent application executed on Mar. 14, 2002, may be served.

Hon Hai Precision Ind. Co., Ltd.

C. L. Huang
Chief Financial Officer

Mar. 14, 2002
Date

OPTICAL VARIABLE ATTENUATOR ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to the field of optical attenuators, and more particularly to variable optical attenuators featuring fine adjustment of attenuation.

2. The Related Arts

[0002] Optical attenuators are widely used to control the intensity of optical signals transmitted in an optical network. Optical attenuators are classified as fixed attenuators or variable attenuators. A fixed attenuator provides a fixed attenuation of optical signals, while a variable attenuator allows adjustment of the attenuation of the optical signals. A variety of variable attenuators are available, among which the most commonly used operate by separating ends of coaxially aligned optical fibers to form a gap therebetween. The amount of attenuation achieved by this kind of attenuators is, in general, dependent upon the distance between ends of the two optical fibers. Thus, the attenuation can be controlled by axially displacing one fiber relative to the other to change the distance between the fibers.

[0003] One design for axially displacing optical fibers uses plug-type connectors carrying a first fiber and a second fiber and mating with a coupling device. Attenuation is performed by axially displacing the first fiber relative to the second fiber. An example is shown in US Patent No. 5,734,778 wherein a screw mechanism is attached to a ferrule carrying the first optical fiber. The screw mechanism converts the turning of a nut into a linear displacement of the ferrule. This device, however, can not be finely adjusted. The amount of linear displacement is, in general, dependent upon the screw pitch. Theoretically, a

decrease in screw pitch will lead to finer adjustment. However, physical limitations prevent the screw pitch from being decreased beyond certain limits.

[0004] It is thus desirable to provide a variable optical attenuator wherein an attenuation can be more finely adjusted, thereby overcoming the above mentioned problem.

SUMMARY OF THE INVENTION

[0005] Accordingly, an object of the present invention is to provide a variable attenuating connector providing finer attenuation adjustment.

[0006] Another object of the present invention is to provide a variable attenuating connector employing a double screw mechanism providing finer attenuation adjustment .

[0007] A further object of the present invention is to provide a plug-type variable attenuating connector providing finer attenuation adjustment.

[0008] To achieve the above objects, a variable attenuating connector (VAC) in accordance with the present invention is embodied in the form of a plug-type optical connector carrying a first fiber. This VAC is part of a variable attenuator assembly, which also includes a coupling sleeve and a second plug-type connector with a second fiber. B oth plug-type connectors are connected to the coupling sleeve so that the first and second fibers are held in coaxial alignment. Attenuation of optical signals traveling between the first and second fibers is achieved by varying a distance separating ends of the fibers from each other.

[0009] The VAC comprises a stationary housing defining a longitudinally extending housing bore. A double screw mechanism is attached to a rear end of the housing. The double screw mechanism includes an elongate, tube-shaped ferrule

holder accommodating the first fiber in its central bore and forming a first threaded section on its outer surface. The ferrule holder seats a ferrule in its forward end, the first fiber being firmly held in the ferrule. A tubular adjusting knob forms an inner threaded section of a first screw pitch on its internal surface and an outer threaded section of a second screw pitch on its external surface. Th e first and second screw pitches are different. A connecting nut of the double screw mechanism is held stationary relative to the stationary housing and has a second threaded section formed on the surface of an inner bore. The adjusting knob is threaded onto the ferrule holder, the first threaded section of the ferrule holder threadedly engaging with the inner threaded section of the adjusting knob. The adjusting knob is also partially screwed into the connecting nut, the second threaded section of the connecting nut threadedly engaging with the outer threaded section of the adjusting knob. The ferrule holder is thus attached to the stationary housing with the ferrule holder extending through the housing bore and the ferrule extending a short distance forward of the stationary housing. When the adjusting knob is rotated, the ferrule holder moves relative to the knob in a first direction a first distance corresponding to the first screw pitch, and the knob moves relative to the stationary housing in a second direction opposite to the first direction a second distance corresponding to the second screw pitch. The linear displacement of the ferrule holder (an d the first fiber) relative to the stationary housing is the difference between the first distance and the second distance.

[0010] Other objects, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is a perspective view of a variable attenuator assembly constructed in accordance with the present invention, showing a variable attenuating connector unmated with a coupling sleeve;

[0012] Figure 2 is an exploded view of the variable attenuating connector of Figure 1;

[0013] Figure 3 is an assembled view of the variable attenuating connector of Figure 2, without an external housing, a deformable tube, a protective shield, or a strain relief;

[0014] Figure 4 is a cross-sectional view taken along line 4-4 of Figure 3;

[0015] Figure 5 is a cross-sectional view taken along line 5-5 of Figure 4;

[0016] Figure 6 is a cross-sectional view of an adjusting knob of the variable attenuating connector of Figure 2; and

[0017] Figure 7 is an assembled, partial, cross-sectional view of the variable attenuator assembly of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] With reference to the drawings, and in particular to Figures 1 and 7, an optical variable attenuator assembly constructed in accordance with the present invention, generally designated with reference numeral 1, comprises a variable attenuating connector (VAC) 11, a coupling sleeve 12 and a second plug-type optical connector 13. The VAC 11 is embodied in the form of a first plug-type optical connector carrying a first optical fiber (not shown). The VAC 11 is designed to mate with the coupling sleeve 12, which also mates with the second plug-type optical connector 13 carrying a second optical fiber (not shown) whereby the first

and second optical fibers are coaxially aligned with each other for transmission of optical signals. Ends of the first and second optical fibers, opposed to each other, can be separated from each other a distance (S) (reference Fig. 7), adjustable by mechanisms of the VAC 11.

[0019] Referring to Figures 2, 3 and 4, the VAC 11 of the present invention comprises a ferrule 50, an external housing 10, an internal housing 20, an U-clip 101, a helical spring 2, a protective sheath 3, a deformable tube 90, a strain relief 100 and a double screw mechanism 110 (see Fig. 3). The internal housing 20 has a front end (not labeled) to which the external housing 10 is connected and a rear end (not labeled) to which the double screw mechanism 110 is connected. The internal housing 20 defines a central bore 206 extending along its longitudinal axis, two holding beams 201, 202 extending from the rear end, a stopping slot 203 in the center accommodating the U-clip 101 and two keyways 204 parallel to the longitudinal axis.

[0020] The double screw mechanism 110 comprises a mounting screw 25, a connecting nut 30, a ferrule holder 60, an adjusting knob 40 and a C-clip 80. The mounting screw 25 defines a central bore 254, two opposite externally-threaded sections 253 at the circumference and two opposite grooves 251, 252 between the two externally-threaded sections 253.

[0021] The connecting nut 30 defines an internally-threaded bore 303 and two opposite grooves 301, 302 at the circumference similar to the grooves 251, 252. Please note that in Figure 4, the internally-threaded bore 303 (not labeled in Figure 4) shows up as a solid, dark mass. This is because the threading is shown on its actual scale, but the lines used in the drawing were not fine enough to resolve the individual threads and instead ran together.

[0022] As shown in Figure 6, the adjusting knob 40 is tubular in shape having a bore (not labeled) along its longitudinal axis and a circumferential rib 403. Internal threads 402 are formed on an internal surface of the bore (not labeled) and external threads 401 are formed on an external surface between the circumferential rib 403 and a forward end (not labeled) of the adjusting knob 40. The internal threads 402 have a first screw pitch and the external threads 401 have a second screw pitch, the two screw pitches being different.

[0023] The ferrule holder 60 defines a central bore 607 for receiving the first optical fiber, two stoppers 601 on an enlarged front end (not labeled), an externally-threaded section 602 in a center of an external surface and a circumferential slot 603 in a rear end (not labeled) for receiving and retaining the C-clip 80.

[0024] Referring to Figures 2, 3 and 5, in assembly, the helical spring 2 slides over the ferrule holder 60 and is pushed forward to the front end of the ferrule holder 60. The mounting screw 25, the connecting nut 30 and the adjusting knob 40 in turn receive the ferrule holder 60 with the externally-threaded section 602 threadedly engaging with the internal threads 402 of the knob 40, and with the knob 40 being partially received in the connecting nut 30 with the external threads 401 of the knob 40 threadedly engaging with the internally-threaded bore 303 of the connecting nut 30. The C-clip 80 is received in the circumferential slot 603 of the ferrule holder 60 for limiting the rearward movement of the adjusting knob 40. The ferrule holder 60 is inserted into the central bore 206 of the internal housing 20, with the front end thereof located in the internal housing 20 and the stoppers 601 engaging with the keyways 204 of the internal housing 20 to prevent the ferrule holder 60 from rotating relative to the internal housing 20. The mounting screw 25 and the connecting nut 30 are fixed on the rear end of the internal housing 20 by

the four grooves 251, 252, 301, 302 engaging with the two holding beams 201, 202 of the internal housing 20. The U-clip 101 is inserted into the stopping slot 203 and is fitted around the ferrule holder 60 with the helical spring 2 disposed between the enlarged front end (not labeled) of the ferrule holder 60 and the U-clip 101. The protective sheath 3 is preferably attached to the rear end of the internal housing 20 by engaging with the externally-threaded sections 253 of the mounting screw 25 for shielding and preventing the double screw mechanism 110 from being accidentally actuated. The external housing 10 slides over the front end of the internal housing 20. The ferrule 50 is accommodated in a recess (not shown) defined in the enlarged front end of the ferrule holder 60. The ferrule 50 partially extends beyond the external housing 10 for insertion into the coupling sleeve 12 during mating.

[0025] When being assembled to the first optical fiber (not shown), the fiber is inserted sequentially through the strain relief 100, the deformable tube 90, and through the central bore 607 of the ferrule holder 60. A front end of the fiber is inserted through the ferrule 50. The ferrule 50 is then seated in the recess (not shown) of the enlarged front end of the ferrule holder 60. The deformable tube 90 and the strain relief 100 are attached to the rear end of the ferrule holder 60. The deformable tube 90 can be crimped around the rear end of the ferrule holder 60 and the first optical fiber (not shown). The deformable tube 90 is received in the strain relief 100 for fixation and protection of the first optical fiber.

[0026] In use, the ferrule holder 60 moves forward and rearward along its longitudinal axis with respect to the adjusting knob 40 when the adjusting knob 40 is rotated. The external threads 401 and the internal threads 402 of the adjusting knob 40 are arranged in such a way that when the knob 40 makes a turn, the holder 60 is linearly moved with respect to the knob 40 in a predetermined first direction a

distance corresponding to the pitch of the internal threads 402, while the knob 40 is linearly moved with respect to the connecting nut 30 in an opposite second direction a distance corresponding to the pitch of the external threads 401. Thus, a total displacement of the holder 60 and thus the first optical fiber carried therein is equal to the pitch of the internal threads 402 minus the pitch of the external threads 401. Taking 0.25mm and 0.35mm as examples of the pitches of the external threads and internal threads, the displacement induced on the holder 60 is 0.35mm-0.25mm=0.10mm when the knob 40 makes a full turn. This gives a finer resolution in adjusting the distance (S) between the first and second optical fibers (reference Fig. 7) and thus improves upon a variable optical attenuator of the prior art.

[0027] The second plug-type optical connector 13 need not have a double screw mechanism 110 or other adjusting mechanism for the optical variable attenuator assembly 1 to be fully functional. Normally, the second plug-type optical connector 13 of Figure 1 will have a second optical fiber (not shown) stationary with respect to the second plug-type optical connector 13. Please also note that other plug-receptacle combinations and configurations are meant to be encompassed by the present invention. For instance, the coupling sleeve 12 and second plug-type optical connector 13 could be replaced by a receptacle connector.

[0028] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

CLAIMS

We claim:

1. A variable attenuator assembly for attenuating optical signals transmitted between a first and a second optical fibers, comprising:

a plug-type connector terminating the second optical fiber;

a coupling sleeve open at two opposite ends; and

a variable attenuating connector (VAC) terminating the first optical fiber, comprising:

a stationary housing defining a longitudinally extending bore and having a rear end;

a connecting member attached to the rear end of the stationary housing and defining an internally-threaded bore;

a tubular knob having an external threads of a first screw pitch and an internal threads of a second screw pitch, the first and second screw pitches being different, the tubular knob being partially received in the connecting member with the external threads of the knob mating with the internally-threaded bore of the connecting member; and

a ferrule holder defining a central bore adapted to receive and retain an optical fiber therein, the holder being received in the tubular knob and the stationary housing and having external threads mating with the internal threads of the knob;

wherein rotating the knob induces a first linear displacement of the knob with respect to the connecting member and the stationary housing and a second linear displacement of the holder with respect to the knob, the first linear displacement being dependent upon the first screw pitch and the second linear displacement being dependent upon the second screw pitch, whereby the optical fiber is moved with the holder an overall displacement corresponding to the sum of the first and second linear displacements.

2. The variable attenuator assembly as claimed in Claim **1**, wherein the variable attenuating connector further comprises a mounting member attached to the rear end of the stationary housing and defining an external-threaded section and a bore.

3. The variable attenuator assembly as claimed in Claim **1**, wherein the internal threads and the external threads of the knob are arranged such that the first and second displacements are in opposite directions whereby the overall displacement of the optical fiber relative to the stationary housing is the difference between absolute values of the first and second displacements.

4. The variable attenuator assembly as claimed in Claim **1,** further comprising an external housing mounted to a front end of the stationary housing for securing the variable attenuating connector to the coupling sleeve.

5. The variable attenuator assembly as claimed in Claim **1,** further comprising a biasing element arranged between the stationary housing and the holder for biasing the holder.

6. The variable attenuator assembly as claimed in Claim **5**, wherein the biasing element comprises a helical spring disposed between a front end of the ferrule holder and a U-clip inside the housing.

7. The variable attenuator assembly as claimed in Claim **1**, wherein the connecting member forms two grooves which engage with two holding beams formed at the rear end of the housing.

8. The variable attenuator assembly as claimed in Claim **1**, wherein the ferrule holder has an enlarged front end forming a receptacle which receives and retains a ferrule to which the optical fiber is attached.

9. The variable attenuator assembly as claimed in Claim **1**, wherein the ferrule holder forms radially protruding stoppers engaging keyways defined in the sides of the stationary housing for preventing rotation of the holder relative to the housing.

10. A variable attenuating connector (VAC) terminating a first optical fiber, comprising:

a stationary housing defining a longitudinally extending bore and having a rear end;

a connecting member attached to the rear end of the stationary housing and defining an internally-threaded bore;

a tubular knob having an external threads of a first screw pitch and an internal threads of a second screw pitch, the first and second screw pitches being different, the tubular knob being partially received in the connecting member with

the external threads of the knob mating with the internally-threaded bore of the connecting member; and

a ferrule holder defining a central bore adapted to receive and retain the first optical fiber therein, the holder being received in the tubular knob and the stationary housing and having external threads mating with the internal threads of the knob;

wherein rotating the knob induces a first linear displacement of the knob with respect to the connecting member and the stationary housing and a second linear displacement of the holder with respect to the knob, the first linear displacement being dependent upon the first screw pitch and the second linear displacement being dependent upon the second screw pitch, whereby the optical fiber is moved with the holder an overall displacement corresponding to the sum of the first and second linear displacements.

11. The variable attenuating connector as claimed in Claim **10**, wherein the variable attenuating connector further comprises a mounting member attached to the rear end of the stationary housing and defining an external-threaded section and a bore.

12. The variable attenuating connector as claimed in Claim **10**, wherein the internal threads and the external threads of the knob are arranged such that the first and second displacements are in opposite directions whereby the overall displacement of the optical fiber relative to the stationary housing is the difference between absolute values of the first and second displacements.

13. The variable attenuating connector as claimed in Claim **10,** further comprising an external housing mounted to a front end of the stationary housing for securing the variable attenuating connector to a coupling sleeve.

14. The variable attenuating connector as claimed in Claim **10,** further comprising a biasing element arranged between the stationary housing and the holder for biasing the holder.

15. The variable attenuating connector as claimed in Claim **14,** wherein the biasing element comprises a helical spring disposed between a front end of the ferrule holder and a U-clip inside the housing.

16. The variable attenuating connector as claimed in Claim **10,** wherein the connecting member forms two grooves which engage with two holding beams formed at the rear end of the housing.

17. The variable attenuating connector as claimed in Claim **10,** wherein the ferrule holder has an enlarged front end forming a receptacle which receives and retains a ferrule to which the optical fiber is attached.

18. The variable attenuating connector as claimed in Claim **10,** wherein the ferrule holder forms radially protruding stoppers engaging keyways defined in the sides of the stationary housing for preventing rotation of the holder relative to the housing.

19. A variable attenuator assembly for attenuating optical signals transmitted between first and second optical fibers, comprising:

a coupling sleeve open at opposite first and second ends;

a plug-type connector with the second optical fiber, being inserted into the coupling sleeve through said second end;

a variable attenuating connector with the first optical fiber, being inserted into the coupling sleeve through said first end,

said variable attenuating connector comprising:

a stationary housing retained in the coupling sleeve;

a stationary connection member located around a rear portion of the stationary housing and providing an internally threaded bore therein;

a rotatable tubular knob defining external threads with first screw pitch and internal threads with second screw pitch, the external threads engaged within the threaded bore of connector member; and

an irrotational ferrule holder holding the fiber therewith and extending axially in the stationary housing and the rotatable tubular knob, said ferrule holder providing external threads engaged with the internal threads of the knob; wherein

rotation of the knob results in an axial linear displacement of said ferrule holder with an amount being a difference between the first screw pitch and the second screw pitch.

ABSTRACT OF THE DISCLOSURE

A variable attenuator assembly (1) includes a variable attenuating connector (VAC) (11), a coupling sleeve (12), and a second plug-type connector (13). The VAC includes a housing (20) and an attached double screw mechanism (110). The double screw mechanism is finely adjustable because it uses an adjusting knob (40) having a set of external threads (401) and a set of internal threads (402) with two different screw pitches. The external threads engage with an internally threaded bore (303) of a connecting nut (30) attached to the housing. The internal threads engage with outer threading (602) on a ferrule holder (60) received in the adjusting knob. When the adjusting knob is rotated, the knob moves in one direction, and the ferrule holder is moved in the opposite direction, the total distance of ferrule holder movement relative to the housing being proportional to the difference between the screw pitches.

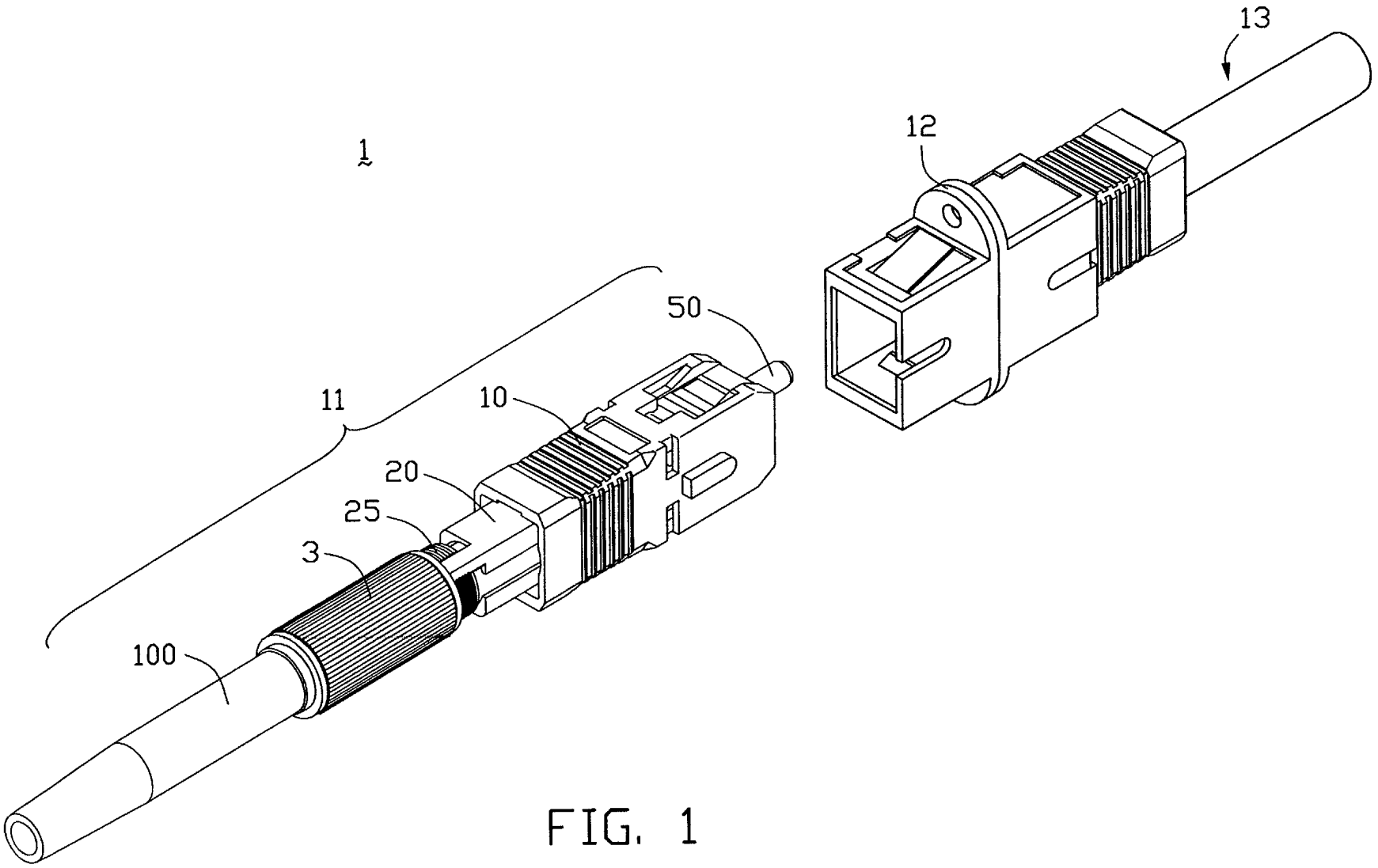
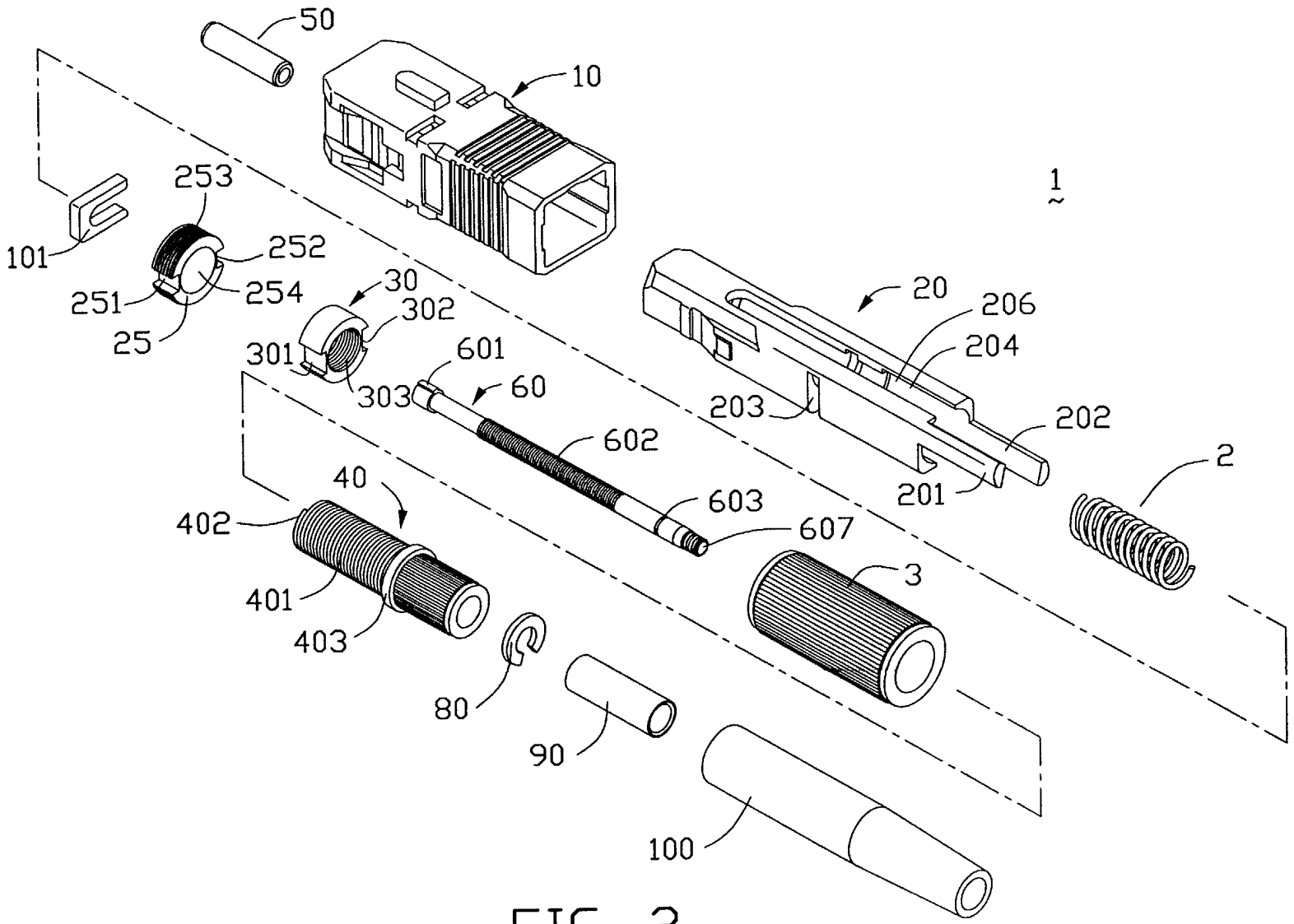


FIG. 1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201

FIG. 2

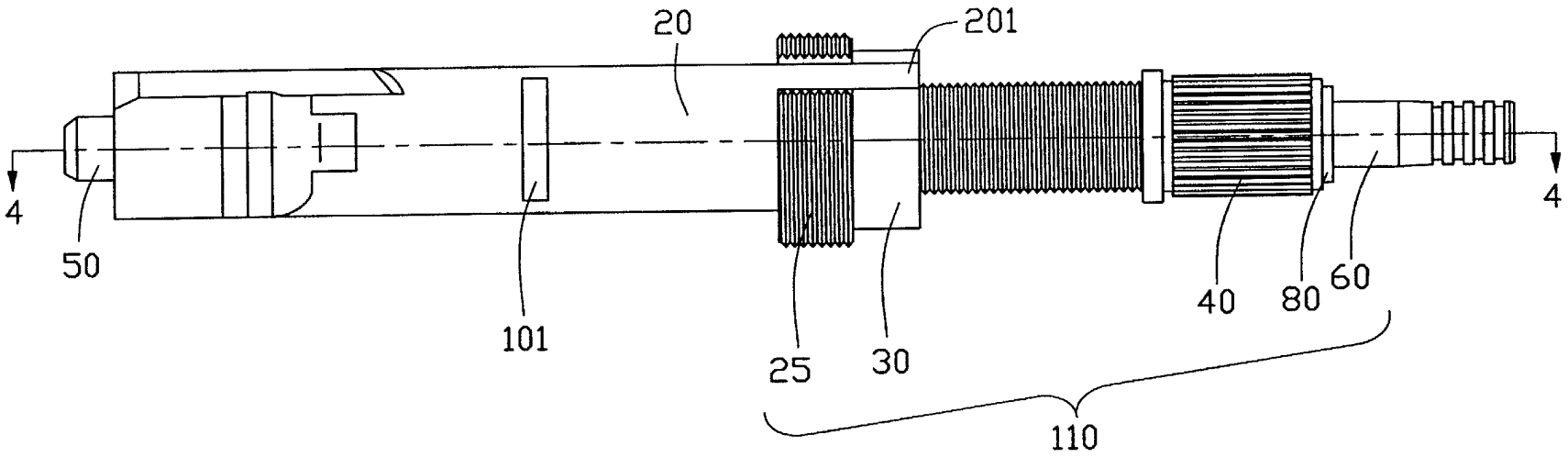

FIG. 3

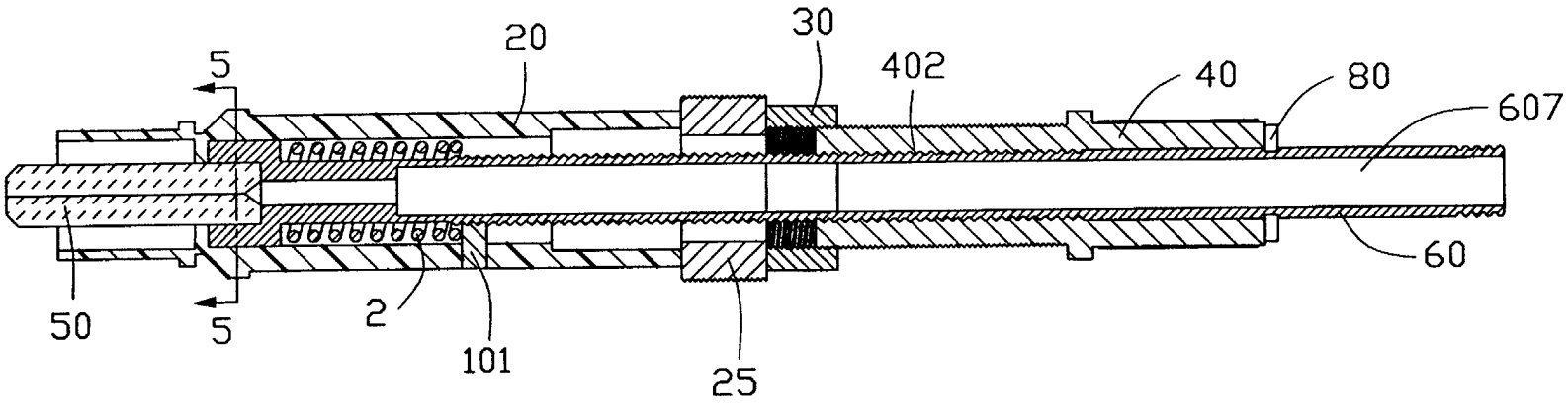

FIG. 4

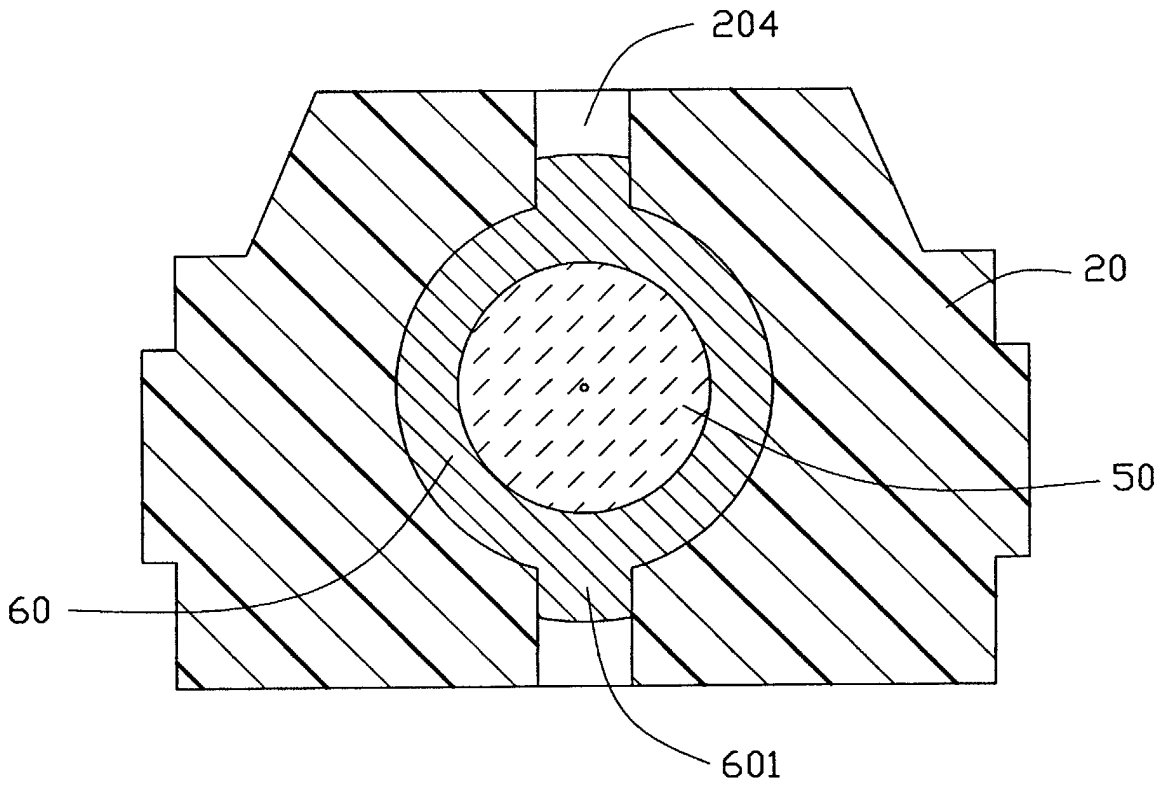

FIG. 5

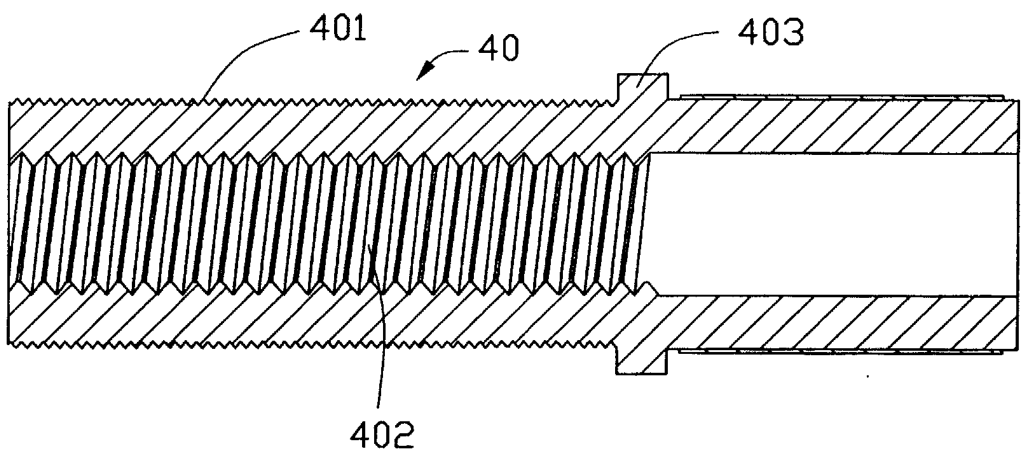

FIG. 6

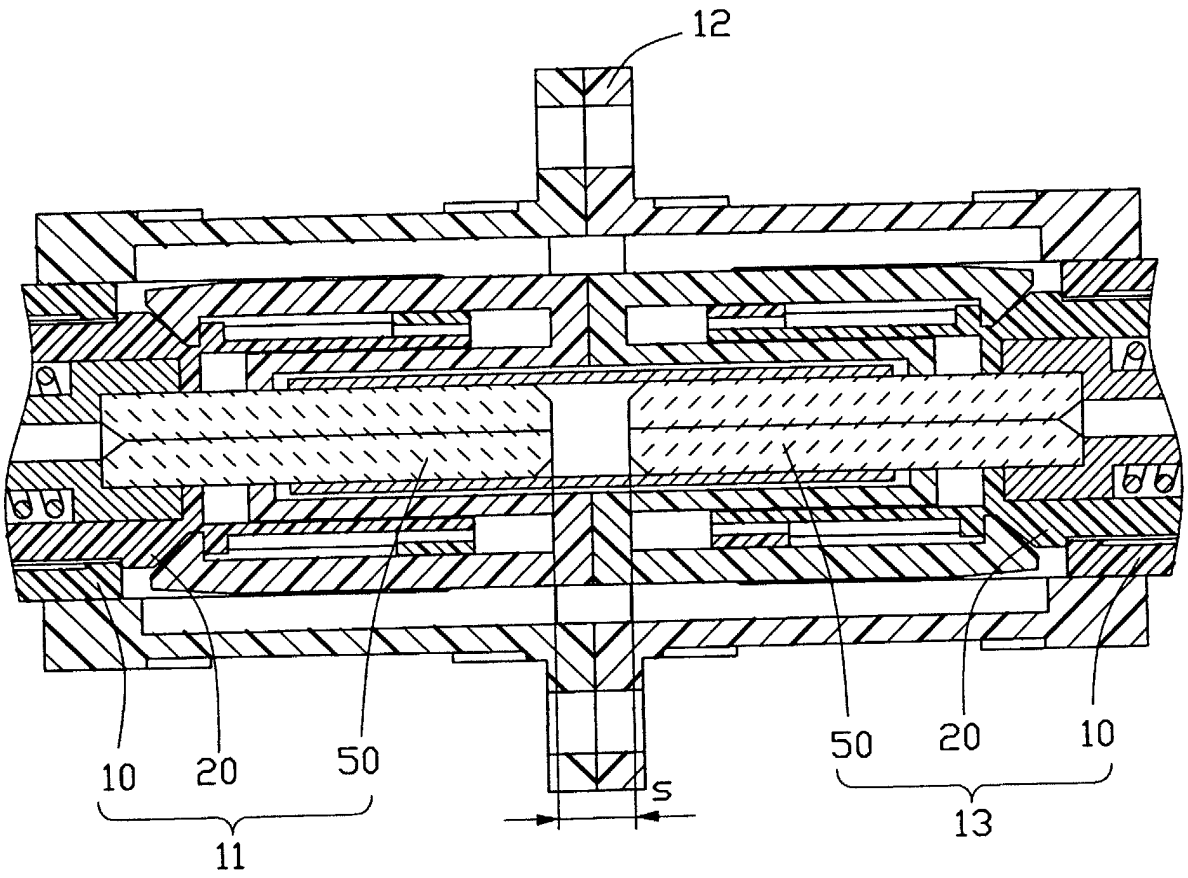

FIG. 7

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	
First Named Inventor	Chih-Chiang Chang
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

OPTICAL VARIABLE ATTENUATOR ASSEMBLY

(Title of the Invention)

the specification of which
☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
90221150	Taiwan	Dec/05/01	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☒ Customer Number 25859 → *Place Customer Number Bar Code Label here*

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PATENT TRADEMARK OFFICE

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25859
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Country		Telephone		Fax	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Chih-Chiang	Chang

Inventor's Signature	Chih-Chiang Chang					Date	03/14/02
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City	Santa Clara	State	CA	ZIP	95050	Country	U.S.A.

☐ Additional inventors are being named on the ___ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto